I-29 MOO University

2025 Dairy Beef Short Course

In collaboration with

Iowa State University Extension and Outreach

University of Minnesota Extension

Nebraska Extension

South Dakota State University Extension

Funded by the Beef Checkoff

WE WANT TO HEAR FROM YOU.

Nobody understands the challenges and opportunities facing dairy producers better than you do. Your insights will help us serve you more effectively.

SCAN TO TAKE THE SURVEY

1. Open the camera app on your smart device
2. Point it at the square QR code
3. Click the website link that appears

@BeefCheckoff

BEEF

Funded by the Beef Checkoff

Table of Contents

Agenda

Time	Session
9:00 AM	**Registration opens**
9:45 AM	Kimmi Devaney - **Program welcome**
10:00 AM	Dr. Joe Armstrong - **Vaccines 201 & Vaccine Protocols**
10:45 AM	Dr. Kendall Swanson - **Energetics of changes in liver size and health in calves**
11:30 AM	Dr. Dathan Smerchek - **The Effect of Growth Enhancing Technologies on Mineral Requirements in Beef Cattle**
12:00 PM	**Q&A Session** - Kimmi Devaney moderating
12:15 PM	Lunch
1:15 PM	Dr. Warren Rusche - **What's Going on with Carcass Size?**
2:00 PM	Panel Discussion on **Facilities: The good, the bad, and the ugly**
3:00 PM	**Final thoughts & evaluation**
3:15 PM	Adjourn

Speaker Biographies

KIMMI DEVANEY

Kimmi Devaney is an editor for Progressive Dairy magazine and co-host of the Progressive Dairy Podcast. After graduating from Washington State University, she pursued a career in public relations with a passion for bridging the information gap between farmers and consumers and gained a deep appreciation for the power of storytelling and relationship building. She spent more than a decade equipping agricultural organizations and farmers with the tools and support to build consumer trust through media relations, spokesperson training/coaching, online storytelling, stakeholder engagement and crisis communications before joining the Progressive Dairy editorial team in 2022. Kimmi covers business management, farm safety, mental health, cow comfort, facilities, grazing, organic, niche market and policy topics for the magazine and a variety of dairy-related topics on the podcast.

JOE ARMSTRONG, DVM

Dr. Joe Armstrong is a member of the Zoetis Dairy Technical Service Team and focuses on helping dairy and beef operations with the practical application of evidence-based medicine and management. With Zoetis, he is responsible for providing technical support to Minnesota, western Wisconsin, and northeast Iowa. Joe received his bachelor's degree in biology from the University of Minnesota-Morris in 2011. He graduated from the University of Minnesota-College of Veterinary Medicine in 2015. After veterinary school, Joe worked as a private practitioner with beef and dairy farms at Anderson Veterinary Service in Zumbrota, MN. Dr. Joe then worked as the Cattle Production Systems Extension Educator at the University of Minnesota. Joe lives in the Twin Cities of MN with his wife, who is also a veterinarian, and his two children.

Speaker Biographies

KENDALL SWANSON, PHD

Kendall Swanson is a Professor of Beef Production Systems in the Department of Animal Sciences at North Dakota State University. Kendall grew up on a crop and livestock farm in southeastern North Dakota. He received his BS and MS in Animal and Range Sciences at North Dakota State University and his PhD in Ruminant Nutrition at the University of Kentucky. He then worked as a Research Associate at the USDA Meat Animal Research Center. Before returning to North Dakota in 2010, Kendall was on faculty at the University of Guelph. Kendall's research program focuses on improving the efficiency of feed utilization of finishing cattle and pregnant cows, and on digestive physiology and energy metabolism in ruminants. He also teaches undergraduate and graduate courses in nutrition and physiology and serves as the department graduate coordinator.

DATHAN SMERCHEK, PHD

Dathan Smerchek completed my B.S. and M.S. degrees in Animal Science at South Dakota State University under the direction of Dr. Zach Smith and his Ph.D. in Animal Science at Iowa State University under the direction of Dr. Stephanie Hansen. He trained in a variety of disciplines including both applied and basic aspects of feedlot and ruminant nutrition. I was fortunate to gain experience in a variety of subject areas including growth enhancing technology utilization, applied feedlot bunk management, applied animal energetics, and trace mineral nutrition and metabolism.

In his role as an Assistant Professor in Animal Science at Iowa State University, his appointment is primarily research focused. His research program is currently in the early stages of development, but the overall goal of his research program is to foster innovation within the beef industry through science-based approaches to improve precision livestock nutritional and technological management to influence the sustainability, productivity, and profitability of the industry.

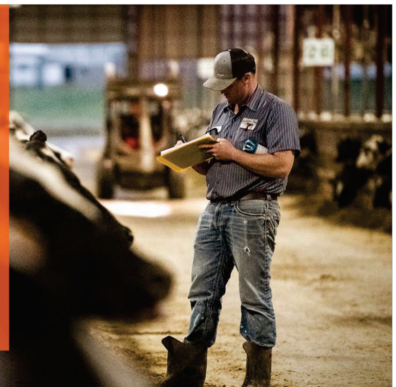
Speaker Biographies

WARREN RUSCHE, PHD

Warren Rusche currently serves as an Assistant Professor and SDSU Extension Beef Feedlot Management Specialist at South Dakota State University. His outreach and research efforts focus on strategies for enhancing the value of crops and livestock to improve rural profitability across South Dakota. Prior to his current role, he served as a cow/calf field specialist based in Watertown and was the co-manager of his family's cow-calf and cattle feeding business in South Dakota for thirteen years. He earned an MS in Animal Science from Kansas State University and a Ph.D. in Animal Science from South Dakota State University.

Vaccines 201 & Vaccine Protocols

Dr. Joe Armstrong



Vaccines 201 and vaccine protocols

Joe Armstrong DVM
Technical Service Veterinarian

Things to keep in mind

- Nothing is black and white – we work in the gray
  - Veterinarians are taught to offer the gold standard but expect to compromise and just want to get as close as possible
- Prevent fires don't just put them out
- Not everything is an economic decision
- Time is worth more than anything
- Producers (should) have lives outside the farm

Born of the Bond zoetis

Hierarchy of importance for calf health

Born of the Bond zoetis

Hierarchy of importance for calf health

1. Colostrum – Quickly, Quantity, Quality, sQueaky clean
2. Dam health and nutrition
3. Calf nutrition
4. Calf environment (pathogen exposure)
5. Calf stress
6. Vaccines
7. Genetics
8. Medications given to calves

Born of the Bond zoetis

What are high-risk cattle?

Born of the Bond zoetis

What are high-risk cattle?

- Long travel
- Put together groups/mixing at concentration points
- Unknown vaccine history
- Too much vaccine
- Too little vaccine
- Light weight
- Young/just weaned/weaning
- Not adapted to environment in which they will be placed

Born of the Bond zoetis

What is a high-risk environment for cattle?

Born of the Bond zoetis

What is a high-risk environment for cattle?

- Dirty/wet
- Poor ventilation
- Inadequate bunk space
- Inadequate water space/access
- Inadequate pen space

Born of the Bond zoetis

What is a high-risk environment for cattle?

- Dirty/wet
- Poor ventilation
- Inadequate bunk space
- Inadequate water space/access
- Inadequate pen space

Operations can't be perfect, but we can strive for excellence.

Sometimes, you can do one wrong and be ok to good if everything else is perfect.

Born of the Bond zoetis

Matching risk to environment

Cattle Risk	Environment Risk	Note
High	High	Bad situation, especially when expectations off
High	Low	Big margin opportunity
Low	High	Opportunity for improvement
Low	Low	Risk averse

Born of the Bond zoetis

Big disclaimers

- Your VCPR holding veterinarian is the best resource for your protocol
- Vaccine protocols are not cookie cutter
- Storage, handling, administration, protocol drift, and protocol review is just as important as protocol design.

Born of the Bond zoetis

How can a vaccine fail?

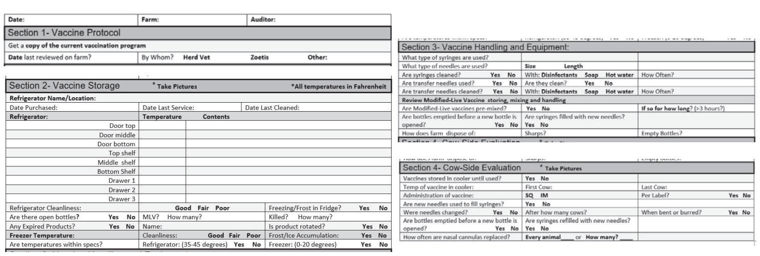
Born of the Bond zoetis

How can a vaccine fail?

- Storage and handling
- Administration
- Overwhelming pathogen load
- Interference from another product
- Immune suppression

How can a vaccine fail?

- Storage and handling – storage most often
- Administration – route and dose, was it given?
- Overwhelming pathogen load – environment
- Interference from another product – What is Protivity?
- Immune suppression – BVD



Date:	Farm:	Auditor:
Section 1- Vaccine Protocol		
Get a **copy of the current vaccination program**		
Date last reviewed on farm?	By Whom? **Herd Vet** **Zoetis** **Other:**	

Section 2- Vaccine Storage	* **Take Pictures**	***All temperatures in Fahrenheit**
Refrigerator Name/Location:		
Date Purchased:	Date Last Service:	Date Last Cleaned:
Refrigerator:	**Temperature**	**Contents**
Door top		
Door middle		
Door bottom		
Top shelf		
Middle shelf		
Bottom Shelf		
Drawer 1		
Drawer 2		
Drawer 3		
Refrigerator Cleanliness:	**Good Fair Poor**	Freezing/Frost in Fridge? **Yes No**
Are there open bottles**?** **Yes No**	MLV? How many?	Killed? How many?
Any Expired Products? **Yes No**	Name:	Is product rotated? **Yes No**
Freezer Temperature:	Cleanliness: **Good Fair Poor**	Frost/Ice Accumulation: **Yes No**
Are temperatures within specs?	Refrigerator: (35-45 degrees) **Yes No**	Freezer: (0-20 degrees) **Yes No**

Section 3- Vaccine Handling and Equipment:		
What type of syringes are used?		
What type of needles are used?	**Size** **Length**	
Are syringes cleaned? **Yes No**	With: **Disinfectants Soap Hot water**	How Often?
Are transfer needles used? **Yes No**	Are they clean? **Yes No**	
Are transfer needles cleaned? **Yes No**	With: **Disinfectants Soap Hot water**	How Often?
Review Modified-Live Vaccine storing, mixing and handling		
Are Modified-Live vaccines pre-mixed?	**Yes No**	**If so for how long?** (>3 hours?)
Are bottles emptied before a new bottle is opened? **Yes No**	Are syringes filled with new needles? **Yes No**	
How does farm dispose of:	Sharps?	Empty Bottles?

Section 4- Cow-Side Evaluation	* **Take Pictures**	
Vaccines stored in cooler until used?	**Yes No**	
Temp of vaccine in cooler:	First Cow:	Last Cow:
Administration of vaccine:	**SQ IM**	Per Label? **Yes No**
Are new needles used to fill syringes?	**Yes No**	
Were needles changed? **Yes No**	After how many cows?	When bent or burred? **Yes No**
Are bottles emptied before a new bottle is opened? **Yes No**	Are syringes refilled with new needles? **Yes No**	
How often are nasal cannulas replaced?	**Every animal____ or How many? ____**	

Reminder - Core Vaccines

- Respiratory core
  - 5-way viral = minimum
    - IBR, PI3, BRSV, BVDV

- Reproductive core
  - 5-way viral + Lepto = 9
    - IBR, PI3, BRSV, BVDV + 5 strains Lepto +/- HB

Reminder - Core Vaccines

- Clostridium – Region and management dependent
  - 7-way = core minimum
    - Blackleg and others
  - +/- red water (C. haemolyticum)
  - +/- tetanus (C. tetani)

Born of the Bond zoetis

Respiratory pathogens

- What respiratory pathogens am I most concerned with?

Born of the Bond zoetis

Respiratory pathogens

- What respiratory pathogens am I most concerned with?

1. BRSV
2. Mannheimia haemolytica
3. BVD
4. +/- Mycoplasma

Not Pasteurella multocida

Born of the Bond zoetis

Respiratory pathogens

- What respiratory pathogens am I most concerned with?

1. BRSV
2. Mannheimia haemolytica
3. BVD
4. +/- Mycoplasma

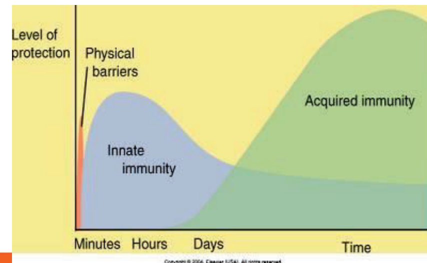
Not Pasteurella multocida

Born of the Bond zoetis

BRSV

Advantages of *intranasal* vaccination

- *Stimulation of local innate immunity*



- Stimulates good response and provides protection at stress periods:
- At Birth (calves)
- At Calving (adult cows)
- Before transportation
- On arrival

•IN vaccination in the face of an outbreak can rapidly induce innate response

93642472

zoetis

Mucosal Immunity, why?

- Mucosal immunity develops faster than systemic immunity and is more important early in an infection[1]
- May result in more rapid induction of acquired immunity[1]
- Intranasal BRSV vaccination provides superior protection to systemic vaccination[2]
- Potential to avoid the impacts of maternal antibody on response to vaccination[3]

[1] Gerber JD, Marron AE, Kucera CJ. Local and systemic cellular and antibody immune responses of cattle to infectious bovine rhinotracheitis virus vaccines administered internasally or intramuscularly. Am J Vet Res 1978;39(5):753-60.
[2] Ellis J, Gow S, West K, et al. Response of calves to challenge exposure with virulent bovine respiratory syncytial virus following intranasal administration of vaccines formulated for parenteral administration. J Am Vet Assoc 2007;230:233-243.
[3] Vangeel I, Antonis AFG, Fluess M, et al. Efficacy of a modified lives intranasal bovine respiratory syncytial virus in 3-week-old calves experimentally challenged with BRSV. Vet J 2007;174:627-635.

3/9/2026

zoetis

Mucosal Immunity, why?

- Mucosal immunity develops faster than systemic immunity and is more important early in an infection[1]
- May result in more rapid induction of acquired immunity[1]
- Intranasal BRSV vaccination provides superior protection to systemic vaccination[2]
- Potential to avoid the impacts of maternal antibody on response to vaccination[3]

[1] Gerber JD, Marron AE, Kucera CJ. Local and systemic cellular and antibody immune responses of cattle to infectious bovine rhinotracheitis virus vaccines administered internasally or intramuscularly. Am J Vet Res 1978;39(5):753-60.
[2] Ellis J, Gow S, West K, et al. Response of calves to challenge exposure with virulent bovine respiratory syncytial virus following intranasal administration of vaccines formulated for parenteral administration. J Am Vet Assoc 2007;230:233-243.
[3] Vangeel I, Antonis AFG, Fluess M, et al. Efficacy of a modified lives intranasal bovine respiratory syncytial virus in 3-week-old calves experimentally challenged with BRSV. Vet J 2007;174:627-635.

3/9/2026

zoetis

Inforce 3

SAFETY AND EFFICACY:
In a safety study conducted with INFORCE 3, no significant adverse reactions related to vaccination were observed. Safety has been demonstrated in calves as young as 0 days of age, weaned calves, high stressed stockers, and pregnant cows in all 3 trimesters.

How is this possible?

Born of the Bond zoetis

Inforce 3 Temperature Sensitive technology

- **Temperature sensitive IBR and PI3**: What does this mean?
  - Chemically altered, and ***validated every 5 years***, to replicate consistently without any change since development 30+ years ago
  - Replicates at temperatures below **102.5°F (39°C)**.
    - Less likely to move systemically
    - Published studies, even in high temperature and high heat index weather (Heat Index 165-175)
      - nasal submucosa temperatures below **99°F.[1,2] (37°C)**
    - Studies also demonstrated
      - nasal submucosa temperatures consistently ran 4-9 °F (2-5°C) below rectal temperatures.
  - "Intranasal (IN) is the preferred route of administration for these vaccines because nasopharyngeal temperatures generally only reach 32°to 34°C, which allows the vaccine virus to replicate unhindered and produce an immune response. [1]"

1. Grissett, et.al., Effect of ambient temperature on viral replication and serum antibody titers following administration of a commercial intranasal modified-live infectious bovine rhinotracheitis parainfluenza 3 virus vaccine to beef cattle housed in high– and moderate–ambient temperature environments, AJVR 75;12, 2014
2. Theurer, et.al., Effects of weather variables on thermoregulation of calves during periods of extreme heat. AJVR 75;3, 2014

Born of the Bond zoetis

What is prime boost?

The basic prime boost strategy involves:

1. **Priming** the immune system to a target antigen delivered by one vector, route, or mechanism, and then
2. selectively **boosting** this immunity by re-administration of the antigen in the context of a second and distinct method.

Several papers have highlighted the power of prime-boost strategies in eliciting protective cellular immunity to a variety of pathogens and have demonstrated efficacy in humans. Coupled with recent advances in our understanding of the mechanisms underlying the generation, maintenance and recall of T-cell memory, the field is poised to make tremendous progress.

Woodland DL[1] Jump-starting the immune system: prime-boosting comes of age. Trends Immunol. 2004 Feb;25(2):98-104.

Born of the Bond zoetis

What is prime boost?

The key strength of this strategy is that greater levels of immunity are established by heterologous prime boost than can be attained by a single vaccine administration or homologous boost strategies.

With some of the early prime boost strategies this effect was merely additive, whereas some newer strategies indicate powerful synergistic effects can be achieved

- More complete immune system stimulation
- Better CMI/T cell stimulation
- Increased number of antigen-specific T cells,
- Selective enrichment of high avidity T cells
- Potentially better local immunity
- Increased efficacy against pathogen challenge

Born of the Bond zoetis

What is prime boost?

Prime boost strategies may include:

1. Different routes of administration
2. Different antigen presentations
3. Modified live and killed
4. Different adjuvants (i.e. different antigen-delivery systems)

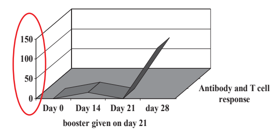
Born of the Bond zoetis

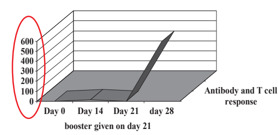
Anamnestic Response

Conventional vs. Prime Boost

Conventional
(Homologous boost)

Prime boost
(Heterologous boost)





>4x higher antibody and T-cell response

Born of the Bond zoetis

NDSU branding/turn out

Group 1 → Intranasal BRSV → BSGOS

Comparison of antibody responses
- 75 calves per group (all IBR naive)
- 55-90 days of age (mean of 74)
- Blocked by age and sex, then randomly assigned
- 150 days between 1st and 2nd immunization

Group 2 → Injectable BRSV → Injectable BRSV

Born of the Bond zoetis

Least squares means of BRSV neutralizing antibody at days 0, 14, 27, 153, and 174

Treatment Group	First Vaccine	Day 0	Day 14	Day 27	Day 153	Day 174
T1	Intranasal BRSV	14.1	8.7	24.1	2.8	15.3
T2	Injectable BRSV	12.9	7.4	14.7	2.1	7.2
P value		ns	ns	*	*	*
T1 vs T2		P = 0.64	P = 0.33	P = 0.003	P = 0.001	P = 0.006

* significant

↑ 1st Vaccine (Day 0) ↑ Boost injectable BRSV (Day 153)

Born of the Bond zoetis

Respiratory pathogens

- What respiratory pathogens am I most concerned with?
  1. BRSV
  2. Mannheimia haemolytica
  3. BVD
  4. +/- Mycoplasma

Not Pasteurella multocida

Born of the Bond

zoetis

ChatGPT generated by input from Katie Browning

zoetis

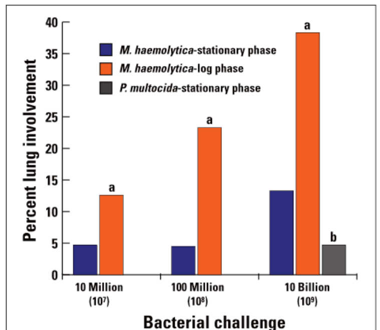
Why is *Mannheimia haemolytica* Important, but not so much *Pasteurella multocida*?

- Researchers attempting to isolate the organism report that *M. haemolytica* is sporadically detectable in the upper respiratory tract of clinically healthy calves [8, 9] Much more prevalent in these calves is *M. haemolytica* type A2, a bacterium that is only rarely associated with respiratory disease.[8,10]
- Following stress or viral or bacterial induced illness, an abrupt shift occurs in the bacterial flora of the calf's nasal passages as the explosive growth and colonization by *M. haemolytica* type A1 supplants the predominance of type A2.[12]
- Under these conditions, large quantities of *M. haemolytica* A1 are inhaled from the nasal cavity and tonsillar crypts and deposited in pulmonary alveoli, leading to the development of pneumonic infection.[14]

8. Frank GH. When *Pasteurella haemolytica* colonizes the nasal passages of cattle. *Vet Med* 1988; 83:1060-1064.
9. Wilkie BN, Shewen PE. Defining the role that *Pasteurella haemolytica* plays in shipping fever. *Vet Med* 1988; 83:1053- 1058.
10. Frank GH. *Pasteurella haemolytica* and respiratory disease in cattle. *Proc 83rd Annu Meet US Anim Health Assoc* 1979;153-160.
12. Gonzalez CT, Maheswaran SK. The role of induced virulence factors produced by *Pasteurella haemolytica* in the pathogenesis of bovine pneumonic pasteurellosis: review and hypotheses. *Br Vet J* 1993; 149:183-193.
14. Frank GH. Proc 72nd Annu Meet Conf Res Workers in *Anim Dis. Chicago,* 1991; 272 abstract.

zoetis

Dose:Damage



[a] *M. haemolytica* log phase mean differs significantly ($P \le 0.05$) from stationary phase mean for the respective concentration of inoculum.
[b] *P. multocida* mean differs significantly ($P \le 0.05$) from both *M. haemolytica* stationary and log phase means for the respective concentration of inoculum.

Figure 2 – Lung damage in calves challenged with *M. haemolytica* and *P. multocida*

Ames, et al., Can J Comp Med 1985

zoetis

The Pathogenesis of *Pasteurella multocida*

- While explosive growth and colonization with *M. haemolytica* A1 occurs, the colonization rate of *P. multocida* does not change. Thus, ***it appears that P. multocida colonization of the lung is dependent upon or greatly enhanced by the initial damage caused by M. haemolytica***

- The relationship between the activity of *M. haemolytica* and *P. multocida* helps explain the observation of laboratory diagnosticians that the ***bacterial species isolated from typical pneumonic lung lesions changes depending upon the stage of the disease*** at time of death with *P. multocida* isolation typically found only in late-stage disease

13. Whiteley LO, Maheswaran SK, Weiss DJ, et al. *Pasteurella haemolytica* A1 and bovine respiratory disease: pathogenesis. *J Vet Int Med* 1992; 6:11-22.

What is the most important virulence factor for M. haemolytica?

What do we need antibodies against to provide protection?

What is the most important virulence factor for M. haemolytica?

What do we need antibodies against to provide protection?

Leukotoxin

Mannheimia haemolytica

University of Minnesota Cont.

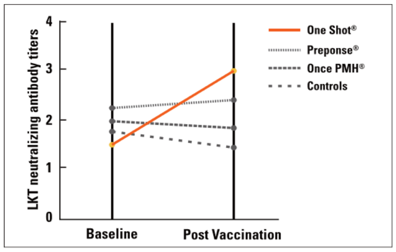


Figure 3 – Leukotoxin neutralizing antibody titers. Only One Shot had a significant (P < 0.05) increase in LKT neutralizing antibody titers at 14 days after vaccination.

Born of the Bond

Zoetis TB; OSBVD-00004

zoetis

Kansas State Cont.

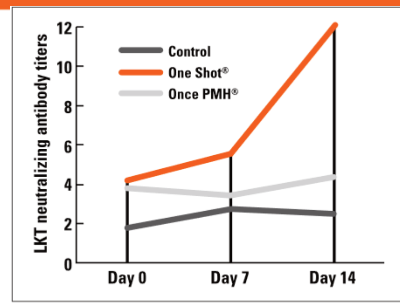


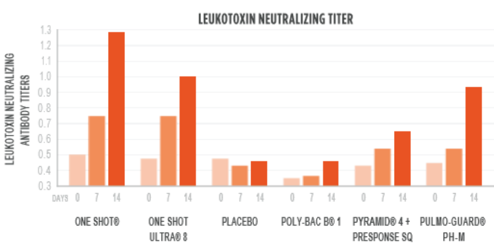
Figure 4 – Mean leukotoxin neutralizing antibody titers. On Day 14, One Shot vaccinates had a significantly (P ≤ 0.05) higher mean LKT neutralizing antibody titer than the controls and Once PMH vaccinates.

Zoetis TB; OSBVD-00004

Born of the Bond

zoetis

Oklahoma State 2001 – Day 0, 7, & 14 day titers



Born of the Bond

Zoetis TB; OSBVD-00004

zoetis

Efficacy of a multivalent modified-live virus vaccine containing a *Mannheimia haemolytica* toxoid in calves challenge exposed with *Bibersteinia trehalosi*

Terry L. Bowersock, DVM, PhD; Brian E. Sobecki, BS; Sarah J. Terrill, MS; Nathalie C. Martinon, DVM; Todd R. Meinert, PhD; Randy D. Leyh, DVM, PhD

Objective—To determine the efficacy of a multivalent modified-live virus (MLV) vaccine containing a *Mannheimia haemolytica* toxoid to reduce pneumonia and mortality rate when administered to calves challenge exposed with virulent *Bibersteinia trehalosi*.

Animals—74 Holstein calves.

Procedures—Calves were assigned to 2 treatment groups. Calves in the control group (n = 36) were vaccinated by SC administration of 2 mL of a commercial 5-way MLV vaccine, and calves in the other group (38) were vaccinated by SC administration of a 2-mL dose of a 5-way MLV vaccine containing *M haemolytica* toxoid (day 0). On day 21, calves were transtracheally administered *B trehalosi*. Serum was obtained for analysis of antibody titers against *M haemolytica* leukotoxin. Nasopharyngeal swab specimens were collected from calves 1 day before vaccination (day –1) and challenge exposure (day 20) and cultured to detect bacterial respiratory pathogens. Clinical scores, rectal temperature, and death attributable to the challenge-exposure organism were recorded for 6 days after challenge exposure. Remaining calves were euthanized at the end of the study. Necropsy was performed on all calves, and lung lesion scores were recorded.

Results—Calves vaccinated with the MLV vaccine containing *M haemolytica* toxoid had significantly lower lung lesion scores, mortality rate, and clinical scores for respiratory disease, compared with results for control calves.

Conclusions and Clinical Relevance—Administration of a multivalent MLV vaccine containing *M haemolytica* toxoid protected calves against challenge exposure with virulent *B trehalosi* by reducing the mortality rate, lung lesion scores, and clinical scores for respiratory disease. (*Am J Vet Res* 2014;75:770–776)

AJVR, Vol 75, No. 8, August 2014

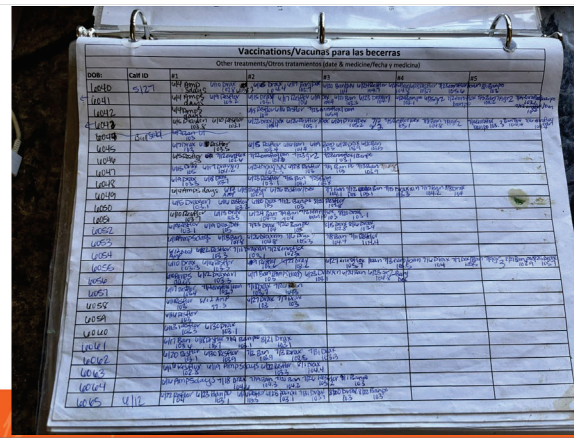
Born of the Bond

zoetis

Respiratory pathogens

- What respiratory pathogens am I most concerned with?
  1. BRSV
  2. Mannheimia haemolytica
  3. BVD
  4. +/- Mycoplasma

Not Pasteurella multocida



Timing first BVD?

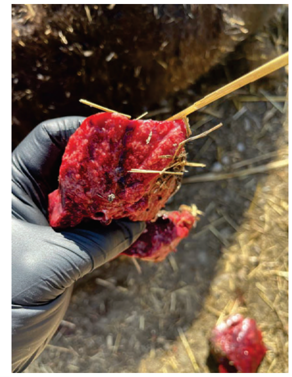
- Maternal interference vs likelihood of exposure
  - PI likely or not?
    - Biosecurity and surveillance?
    - Comingled sources?
- Risk mitigation – cover major virals
  - Inforce 3 = BRSV, IBR, PI3
  - OneShot BVD = BVD
- Refined vaccine – OneShot vs OneShot BVD

Respiratory pathogens

- What respiratory pathogens am I most concerned with?
  1. BRSV
  2. Mannheimia haemolytica
  3. BVD
  4. +/- Mycoplasma

Not Pasteurella multocida

Born of the Bond zoetis



Born of the Bond zoetis

Mycoplasma

- Relatively new disease – first isolated in the 1960's
- Recognized with increasing frequency as a cause of disease in cattle
- Creates big diagnostic and treatment problems on feedlots and dairy farms
- Most commonly causes respiratory diseases, otitis, and arthritis in calves
- Can be incredibly hard to deal with on some farms

Born of the Bond zoetis

Mycoplasma

- Smallest free-living organism that is capable of self-replication
- No cell wall – instead they are covered by a thin membrane
- Live primarily in animals – however can survive for short periods in the environment
- Can survive for nearly 2 months in sponges and milk, over 2 weeks in water and 20 days in straw (**J Vet Med A 1984:258:38-41**)

Born of the Bond zoetis

Mycoplasma - Disease

- Often found in combination with other causes of BRD
- Causes significant immunosuppression and often leads to chronic pneumonia **(Front Vet Sci 2020;7:609443)**
- However, it also can be a primary cause of pneumonia in some farms
- Bacteria can persist for weeks to months after initial infection – primarily in necrotic lung **(Vet Microbiol 2013;162:949-953)**
- Clinical signs not really different from other BRD causes

Born of the Bond zoetis

Born of the Bond zoetis

Vaccination

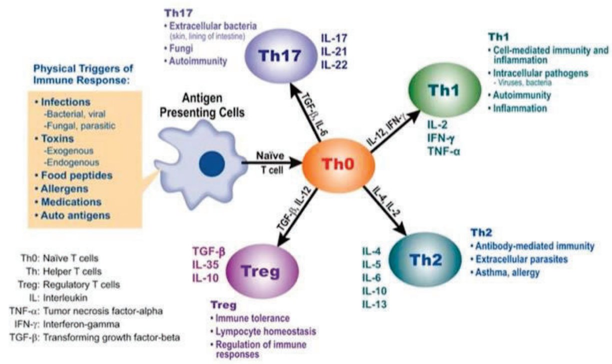
- Historically – autogenous and commercially available killed vaccines have been used by farms
- No field trial to date has demonstrated any efficacy of Mycoplasma vaccination with killed or autogenous vaccines
- Large study in Florida across 4 dairy herds suggested that vaccination with killed or autogenous vaccines actually increased the rate of disease **(Vaccine 2009; 27:2781-2788)**

Born of the Bond zoetis

Mycoplasma Immunology – What we know

- The protective response is primarily driven by improved macrophage mediated killing early in the course of disease.
- Appears to be largely IFN gamma driven by T helper cells
- Neutrophil mediated killing is not terribly effective for M. bovis and continued neutrophil recruitment may be a part of the continued tissue damage **(Vet Immunol Immunopathol 2017;188:27-33)**
- There are clearly strain related differences in pathogenicity but how they relate to the immune response is yet unclear

Born of the Bond Vet Clin Food Anim. 2019;35:471–483 zoetis



Dittel B. When IT All Goes Wrong and Your Immune System Attacks Its Own Body.; 2018. Accessed May 2, 2024

Born of the Bond

zoetis

Mycoplasma - Immunology

- During natural infection - Mycoplasma wants to drive a Th2 response and suppress the Th1 response
- It does this partially by decreasing IFN-γ production which ↓ the Th1 response **(Infect Immun 2014; 82:62-71)**
- Regulatory T-cells are also significantly increased in *M. bovis* infections
- This increases the presence of "inhibitory cytokines" like TGF-β and IL-10 (Front Vet Sci 2020; 7:609443)

Born of the Bond

zoetis


Vaccine 32 (2014) 3107–3114

Contents lists available at ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

Attenuated *Mycoplasma bovis* strains provide protection against virulent infection in calves

Rui Zhang[a,b], Xiaoxiao Han[a,b], Yingyu Chen[a,c], Riaz Mustafa[a,b], Jingjing Qi[a,b], Xi Chen[a,b], Changmin Hu[a,b], Huanchun Chen[a,b], Aizhen Guo[a,b,*]

[a] The State Key Laboratory of Agricultural Microbiology, Huazhong Agricultural University, Wuhan 430070, China
[b] College of Veterinary Medicine, Huazhong Agricultural University, Wuhan 430070, China
[c] College of Animal Science, Huazhong Agricultural University, Wuhan 430070, China

- Studies have indicated that the use of live, avirulent *Mycoplasma bovis* vaccines can protect against clinical challenge

Born of the Bond

zoetis


genes

MDPI

Article

Calves Infected with Virulent and Attenuated *Mycoplasma bovis* Strains Have Upregulated Th17 Inflammatory and Th1 Protective Responses, Respectively

Jin Chao[1,2,3,4], Xiaoxiao Han[1,2], Kai Liu[1,2], Qingni Li[1,2], Qingjie Peng[5], Siyi Lu[1,2], Gang Zhao[1,2], Xifang Zhu[1,2], Guyue Hu[1,2], Yaqi Dong[1,2], Changmin Hu[2], Yingyu Chen[1,2], Jianguo Chen[2], Farhan Anwar Khan[1], Huanchun Chen[1,2,3,4] and Aizhen Guo[1,2,3,4,*]

- I mmune response compared between infection between virulent *M. bovis* and avirulent strains
- The avirulent strain was able to create an IFN dominated Th1 response, suppress the Th2 response and downregulate the Th17 response

Born of the Bond

zoetis

Protivity

- Avirulent live *M. bovis* vaccine recently released in North America
- Approved for administration in calves at 1 week of age with a booster 3 weeks later
- Has been used successfully as another tool to help control Mycoplasma infections in calves

Protocol

Arrival
INFORCE™ 3 DOSE - 2ml, single nostril (Intranasal)
Dip Navel with tincture of iodine (at least 7%)

Arrival
INFORCE™ 3 DOSE - 2ml, single nostril (Intranasal)
Dip Navel with tincture of iodine (at least 7%)

48-72 hours after arrival AND 30 days of age
PROTIVITY™ DOSE - 2 ml SQ

Arrival

INFORCE™ 3 DOSE - 2ml, single nostril (Intranasal)

Dip Navel with tincture of iodine (at least 7%)

48-72 hours after arrival AND 30 days of age

PROTIVITY™ DOSE - 2 ml SQ

6-7 weeks of age

INFORCE™ 3 DOSE - 2ml, single nostril (Intranasal)

ONE SHOT ® BVD DOSE - 2 ml SC

Implant - Synovex C

Arrival

INFORCE™ 3 DOSE - 2ml, single nostril (Intranasal)

Dip Navel with tincture of iodine (at least 7%)

48-72 hours after arrival AND 30 days of age

PROTIVITY™ DOSE - 2 ml SQ

6-7 weeks of age

INFORCE™ 3 DOSE - 2ml, single nostril (Intranasal)

ONE SHOT ® BVD DOSE - 2 ml SC

Implant - Synovex C

5 months of age

Bovi-Shield GOLD One Shot™ - 2 ml SC

ULTRABAC ® 7 DOSE - 5 ml SC

Implant - Synovex Choice

6 months of age

Bovi-Shield GOLD® 5 DOSE - 2 ml SC

ULTRABAC ® 7 DOSE - 5 ml SC

Arrival

INFORCE™ 3 DOSE - 2ml, single nostril (Intranasal)

Dip Navel with tincture of iodine (at least 7%)

48-72 hours after arrival AND 30 days of age

PROTIVITY™ DOSE - 2 ml SQ

6-7 weeks of age

INFORCE™ 3 DOSE - 2ml, single nostril (Intranasal)

ONE SHOT ® BVD DOSE - 2 ml SC

Implant - Synovex C

5 months of age

Bovi-Shield GOLD One Shot™ - 2 ml SC

ULTRABAC ® 7 DOSE - 5 ml SC

Implant - Synovex Choice

6 months of age

Bovi-Shield GOLD® 5 DOSE - 2 ml SC

ULTRABAC ® 7 DOSE - 5 ml SC

Terminal Implant - 180 days left on feed

ULTRABAC ® 7 DOSE - 5 ml SC

Implant - Synovex One Feedlot

Arrival

INFORCE™ 3 DOSE - 2ml, single nostril (Intranasal)

Dip Navel with tincture of iodine (at least 7%)

48-72 hours after arrival AND 30 days of age

PROTIVITY™ DOSE - 2 ml SQ

6-7 weeks of age

INFORCE™ 3 DOSE - 2ml, single nostril (Intranasal)

ONE SHOT ® BVD DOSE - 2 ml SC

Implant - Synovex C

5 months of age

Bovi-Shield GOLD One Shot™ - 2 ml SC

ULTRABAC ® 7 DOSE - 5 ml SC

Implant - Synovex Choice

6 months of age

Bovi-Shield GOLD® 5 DOSE - 2 ml SC

ULTRABAC ® 7 DOSE - 5 ml SC

Terminal Implant - 180 days left on feed

ULTRABAC ® 7 DOSE - 5 ml SC

Implant - Synovex One Feedlot

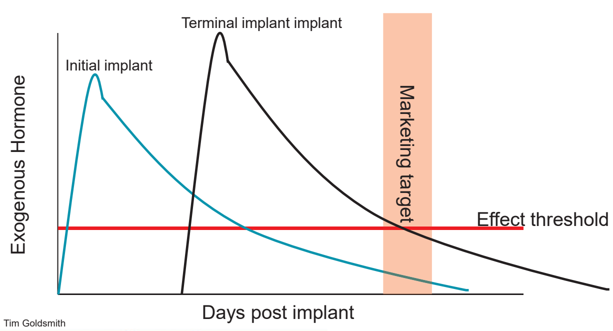
Metaphylaxis needed before 45 days of age
- Excede

First treatment
- Draxxin or Draxxin KP
  - For small number of animals needing treatment, we can still use products labeled for Mycoplasma (and should).

Implant considerations

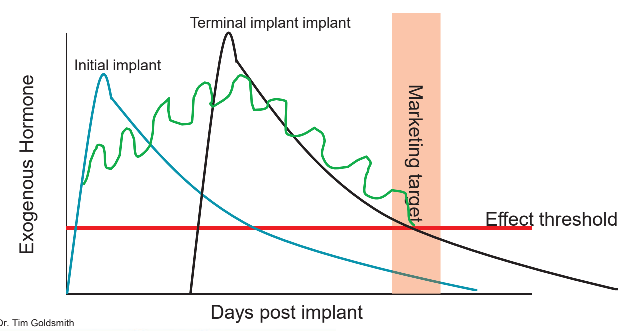
- Always step up in potency – don't go backwards
- Match potency to stage and cattle energy intake
- Start at the end – How many days on feed total?
- Must feed to carcass composition, not a goal weight
  - Implanted cattle need to be fed to a heavier end weight to achieve same quality grade (same days on feed – more pounds to sell)
- FDA guidelines and production phases

Implants – two tradition implant program



Slide adapted from Dr. Tim Goldsmith

Implants – extended release implant



Slide adapted from Dr. Tim Goldsmith

Potency vs Payout

Potency

- Low
  - Low/Medium estrogenic level
- Medium
  - Medium/High estrogenic level
  - Estrogenic + Low Androgenic combo
- High
  - Estrogenic + High Androgenic Combo

Payout = duration

Table 3. Suggested "Pay Outs" for Various Implants Used with Moderate Implant Strategies[1]

	Pay-Out
Synovex® C	70-90 Days
Ralgro®	45-60 Days
Synovex® S/H	60-110 Days
Synovex® Choice	80-110 Days
Revalor®-IS/IH	80-110 Days
Synovex Plus®	100-140 Days
Revalor®-S	80-120 Days
Compudose®	150-180
Encore®	Up to 350 days

[1]Use these as guidelines only. Actual days should vary depending on feed yard management and marketing strategies.

Slide adapted from Dr. Tim Goldsmith

Born of the Bond

Born of the Bond

I-29 MOO University

Energetics of Changes in Liver Size and Health in Calves

Dr. Kendall Swanson

Energetics of changes in liver mass and health in calves

Kendall Swanson
kendall.swanson@ndsu.edu

NDSU

Overview

1. Unique aspects of beef on dairy and dairy calves for finishing
2. GIT development
3. Energetics of liver and GI tissues
   – As influenced by diet, physiological state, etc.
4. Energetics associated with tissue health and repair
5. Final thoughts

NDSU

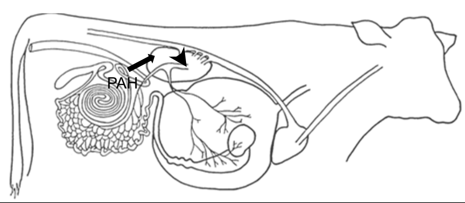
Beef on dairy/dairy

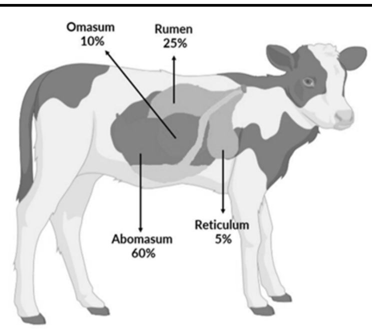
- Dairy genetics – bred to eat
  – Maintenance requirements
  – Differences in growth performance
- Typically fed concentrate diets for long periods of time
- Greater incidence of liver abscesses?

NDSU

Liver Function

- Central organ coordinating whole animal nutrient use and metabolism

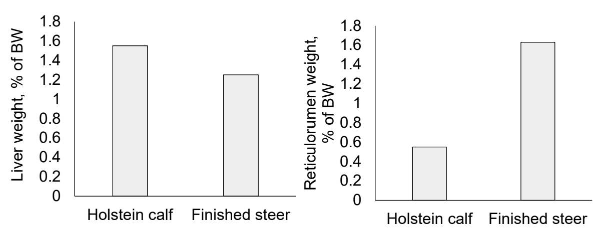




NDSU

www.dairy.extension.wisc.edu

Relative weights of liver and reticulorumen



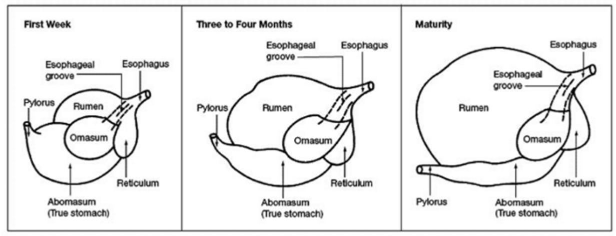
NDSU

Reiners et al 2022
Mader et al 2009

Development of liver and GIT

- Liver development largely complete before birth
- GIT development
  - Non-ruminant to ruminant transition

Figure 1. Development of bovine stomach compartments from birth to maturity.



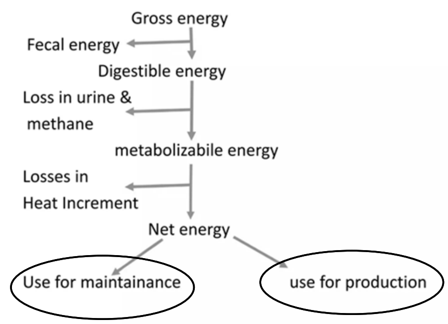
www.calfcare.ca

Factors influencing energetic efficiency

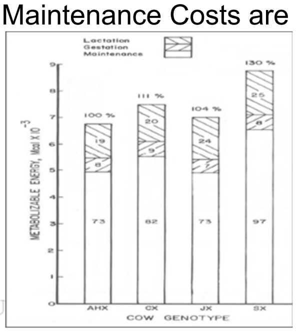
Table 19.2. Potential whole-animal and metabolic (tissue, cellular and molecular) factors regulating feed efficiency in cattle.

Whole animal	Metabolic (tissue, cellular and molecular)
Physiological state	Differential cellular turnover and tissue growth
Production/genetic potential	Ion transport
Body composition	Protein turnover
Feed intake	ATP synthesis/mitochondrial proton leak
Nutrient digestion and absorption:	
Ruminal	Nucleic acid and phospholipids turnover
Post-ruminal	
Nutrient/energy losses:	
Faecal/urine	Urea synthesis
Heat production	
Stress susceptibility	Substrate cycling
Health/immune status	Differential expression of energetically demanding and regulatory proteins
Systemic hormones	Genetic polymorphisms
Physical activity	

Swanson & Miller, 2008

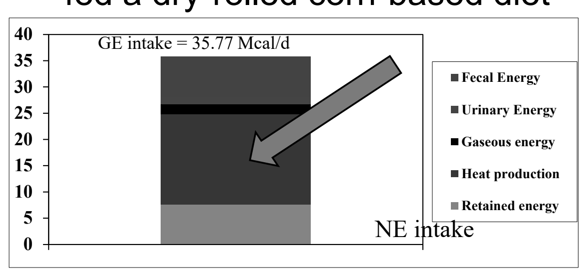


Maintenance Costs are Significant



Beef Cattle

Energy Balance – beef finishing steers fed a dry-rolled corn-based diet



Data from Archibeque et al 2006

Tissue energy use dependent on:

- Tissue mass (g and % of BW)
- Metabolic activity
  - Energy use per g of tissue
    - Often measured as oxygen consumption
- Tissue health
  - Nutrient/energy requirements increase with compromised tissue health

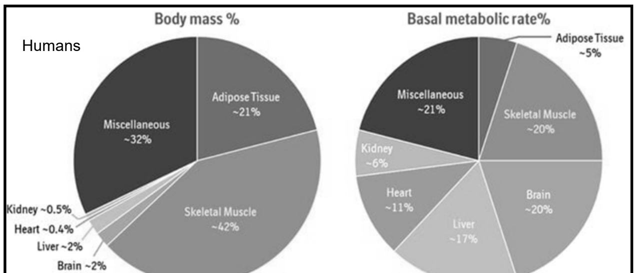
NDSU

Importance of specific tissues (maintenance requirements)

- Visceral+ tissue (gut, liver, heart, lungs, pancreas, mesenteric fat, etc.)
  - 6 – 10% of BW
  - 40 – 50% of oxygen consumption
- Gastrointestinal tract
  - 20 – 25% of oxygen consumption
- Skeletal Muscle
  - Approx 40% of empty body weight
  - Approx 21% of energy use

NDSU

Humans



NDSU

Loffler et al 2021

TABLE 1. *Contribution of the major oxygen-consuming organs of the body to body mass and standard metabolic rate*

Organ	Body Mass, % Human	Body Mass, % Rat	Body Oxygen Use, % Human	Body Oxygen Use, % Rat
Liver	2	5	17	20
Gastrointestinal tract	2	5	10	5
Kidney	0.5	0.9	6	7
Lung	0.9	0.6	4	1
Heart	0.4	0.5	11	3
Brain	2	1.5	20	3
Skeletal muscle	42	42	20	30
Total	49.8	55.5	88	69

NDSU

Rolfe and Brown 1997

NDSU

Expensive Tissue Hypothesis

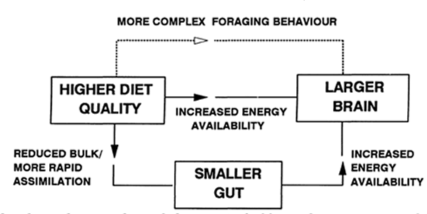


Fig. 5. *High-quality diet and increased encephalization.* Dashed line, *selection pressure;* solid lines, *relaxed constraints.*

NDSU

Aiello and Wheeler 199

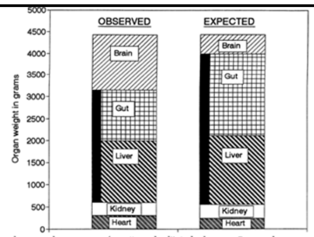


FIG. 3. *Observed and expected organ mass for a "standard" 65-kg human. Expected organ masses for heart, liver, and kidneys from Stahl (1965):* heart mass = $5.2M^{0.987}$ (n = 321, r = 0.99); liver mass = $32.2M^{0.94}$ (n = 293, r = 0.98); kidney mass (both kidneys together) = $6.3M^{0.87}$ (n = 268, r = 0.95). *Expected brain size is based on the reduced-major-axis equation computed for higher primates (excluding humans) from data in Stephan, Frahm, and Baron (1981):* brain mass = $\log_{10}Bw = 0.72\log_{10}M + 1.35$ (N = 26, r = 0.98). *Expected gut size is based on the reduced-major-axis equation computed for higher primates from data in Chivers and Hladik (1980) and Chivers, personal communication, 1990 (typesetting errors affecting data accuracy in their table 6 have been corrected, and new species have been added);* gut mass, $\log_{10}GM = 0.853\log_{10}M - 1.271$ (N = 22, r = 0.96). GM, *gut mass (kg);* W, *other-organ mass (g);* M, *body mass (kg);* n, *number of individuals;* N, *number of species;* r, *product-moment correlation coefficient.*

NDS

Aiello and Wheeler 199

Liver is a metabolically active tissue! GIT too!

Table 3. Energy expenditure by various tissues (% of whole body energy use)

Reference	Animal	Physiological state	Nervous tissue	Skin	Heart	Kidney	Digestive tract	Liver	Muscle	Adipose
Ferrell, 1988	Sheep	Mature	12.0	2.7	10.0	5.0	15.0	20.5	23.0	7.0
Smith & Baldwin, 1974	Dairy cow	Non-lactating	17.0[a]	3.5	10.0	-	12.2	22.5	26.0[b]	-
Webster, 1989	Sheep	Mature	-	-	-	-	24.0	28.0	15.0	-
Webster, 1981	Rats		14.0	11.0	-	14.0	8.0	12.0	20.0	-
Baldwin, 1995	Dairy cow	Lactating	-	-	-	-	-	-	-	5.6
Range			14.0-17.0	2.7-11.0	10.0	5.0-14.0	15.0-24.0	12.0-28.0	15.0-26.0	5.6-7.0
Mean			14.0	5.7	10.0	9.5	14.8	21.0	21.0	6.3

[a] Includes kidney; [b] Total carcass (includes bone and adipose).

NDSU

Caton et al, 2000

What influences liver and GIT mass?

- Diet
- Physiological state
- Tissue health
- Other?

NDSU

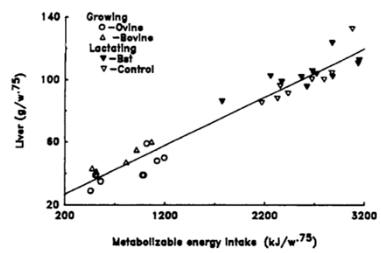


FIGURE 1 Relationship of mean liver weights to mean metabolizable energy intakes reported in several experiments for growing sheep and cattle and for 19 lactating cows (data from Table 2). Bst = bovine somatotropin.

Liver is responsive to changes in nutrition!

Liver abscesses
- Feed intake?
- Variation in intake?
- ADG/NEm requirements

Johnson et al, 1990

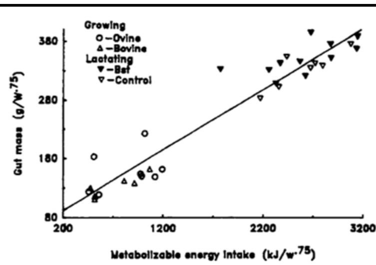


FIGURE 2 Weights of gastrointestinal tract tissue related to metabolizable energy intake in growing sheep and cattle and in lactating cows (data from Table 2). Bst = bovine somatotropin.

Gut mass

NDSU

Johnson et al 199

Table 13-3. Effect of nutritional treatment on organ weight and fasting heat production.[a]

Nutritional treatment	Body weight, kg	Digestive tract, g		Liver, g		Kidney, g	Heart, g	Fasting heat production, Kcal/d
High	44.0	1.889	4.3%	668	1.5%	121	155	1,674
Medium	47.2	1.653		625		114	143	1,549
Low	39.9	1,304		428		93	126	1,143
Very low	34.4	1,162	3.4%	350	1.0%	83	130	966

[a]Adopted from Ferrell and Jenkins (12)

NDSU

Table 6.12 Estimation of the effects of changes in tissue or organ size upon apparent maintenance requirements of non-lactating and lactating cows[a]

Tissues or organ systems	Non-lactating cow: weight of tissue (kg)	tissue percent of body weight	percent of heat production	MJ/day	MJ/kg tissue	Lactating cow: weight of tissue (kg)	tissue percent of body weight	MJ/day[b]
Kidney and brain system	2.6	0.4	17.0	10.65	4.1	2.6	0.4	10.65
Skin	33.0	5.1	3.5	2.19	0.07	31.3	4.8	2.08
Gastrointestinal	26.4	4.1	7.2	4.51	0.17	33.9	5.2	5.79
Liver	9.1	1.4	22.5	14.1	1.55	11.4	1.8	17.66
Heart	2.6	0.4	10.0	6.26	2.41	3.2	0.5	7.71
Visceral fat	51.1	7.9	5.0	3.13	0.06	42.0	6.5	2.56
Carcass	406.3	62.5	26.0	16.28	0.04	375.2	57.7	15.07
Mammary	13.1	2.0	2.3	1.44	0.11	22.7	3.5	2.5
Other	105.3	16.2	6.5	4.07	0.04	127.7	19.6	4.92
Sum	650.0	100	100	62.63		650	100	68.94
$MJ/kg^{0.75}$ per day				0.46				0.506

[a] Data for 700 kg Holstein cows, assumed empty body weight of 650 kg. Data adapted from Smith and Baldwin (1974).
[b] Based on MJ/kg tissue in non-lactating cow and kg tissue in lactating cow.

NDSU

Baldwin 1995

Table 2
Influence of maternal dietary arginine supplementation and nutrient restriction on offspring BW at 54 ± 4 d of age, hepatic and jejunum mass, and hepatic and jejunal in vitro O_2 consumption.

Item	Con[a]	Res[b]	Res-Arg[c]	SEM[d]	P: Con vs others[e]	P: Res vs Res-Arg[f]
BW, kg	22.9	21.0	23.5	1.2	0.64	0.16
Hepatic weight						
g	470	414	464	24	0.31	0.16
g/kg BW	20.7	19.8	19.7	0.7	0.30	0.99
Hepatic O_2 consumption						
mol/min/g liver	0.387	0.352	0.335	0.020	0.09	0.57
mol/min/liver	181	146	155	10	0.04	0.53
mol/min/kg BW	8.00	6.67	6.83	0.40	0.02	0.77
Jejunum weight						
g	163	186	172	27	0.63	0.71
g/kg BW	7.50	8.91	7.39	1.4	0.69	0.40
Jejunum O_2 consumption						
mol/min/g jejunum	0.349	0.378	0.345	0.020	0.60	0.26
mol/min/jejunum	58.2	71.0	59.8	11.9	0.62	0.48
mol/min/kg BW	2.40	3.17	2.50	0.50	0.50	0.35

[a] Con = 100% of dietary requirements [16].
[b] Res = 60% of control.
[c] Res-Arg = Res with the addition of a rumen-protected arginine supplement containing 180 mg arginine/kg BW.
[d] SEM = standard error of the mean, n = 6.
[e] Con versus others.
[f] Res versus Res-Arg = difference between means determined using contrast statements.

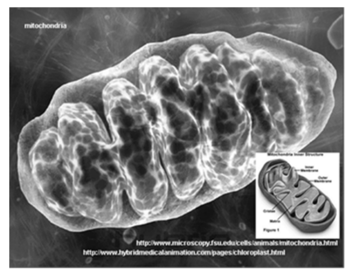
NDSU

Prezotto et al 201

Tissue/cellular events contributing to energy use

- Relative tissue size/cell size
- Differs depending on tissue
  - Ion transport, protein turnover, cell regeneration (nucleic acid turnover), ureagenesis, gluconeogenesis, substrate cycling, lipid turnover, etc.
  - Uncoupling

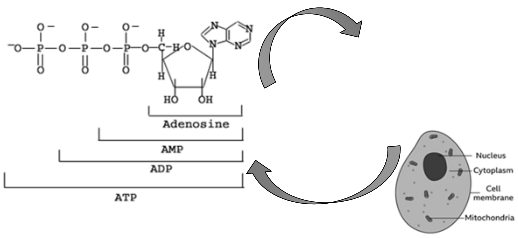
NDSU



NDSU

http://microbewiki.kenyon.edu/index.php/Mitochondria

Adenosine Triphosphate (ATP)



NDSU

ATP synthesis by oxidative phosphorylation is the fundamental means of cell energy production in animals,
plants and almost all micro-organisms. A typical 70 kg human with a relatively sedentary lifestyle will generate around **<u>2.0 million kg</u>** of ATP from ADP and Pi in a 75-year lifespan.

Senior et al 2002

NDSU

Does liver mass increase when abscesses are present?

- Probably yes. Current research ongoing.
- Hepatic tissue or abscessed tissue?
- What is the energy requirement of increased liver mass?
- What is the energy requirement of abscessed tissue?
  - Inflammation, immune response, and tissue repair

NDSU

Assume increased mass is non-abscessed liver

- Assume liver consumes 20% of NE for maintenance and is 1.25% of BW
- 1500 lb steer = 18.75 lb liver
- NEm required = 9.5 Mcal (1.9 Mcal for liver)
- If increase liver to 1.5% of BW = 22.5 lb (1.2 fold): 1.9 Mcal × 1.2 = 2.28 Mcal (0.38 Mcal additional NEm required)
  - Increase NEm to 9.9 Mcal
    - ~4.2% increase in NEm required
    - Decrease in energy available for growth

NDSU

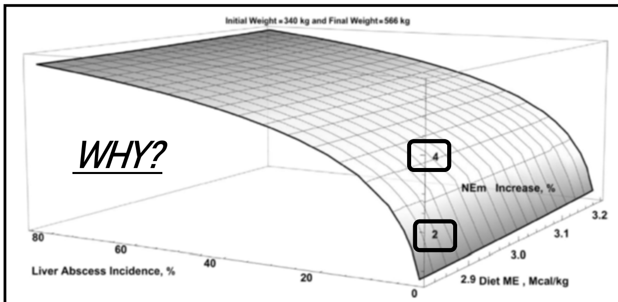
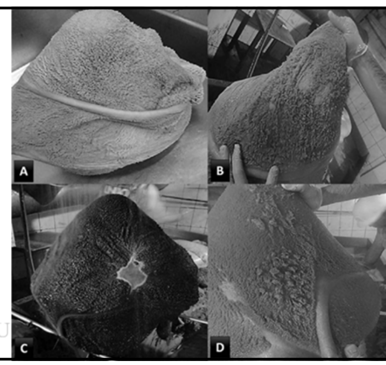


Fig. 1. Estimation of the impacts of liver abscess incidence on net energy requirements for maintenance of feedlot cattle.

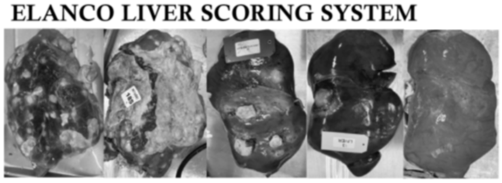
Batista and Holland, 2022



NDSU

Viana et al 2022

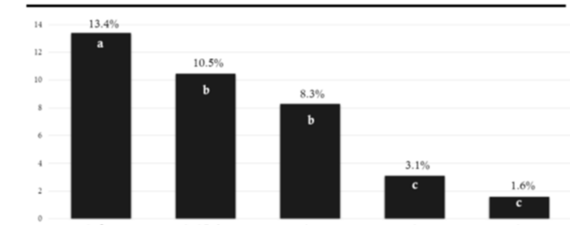
ELANCO LIVER SCORING SYSTEM



A+ Open | A+ Adhesion | A+ | A | A-

NDSU

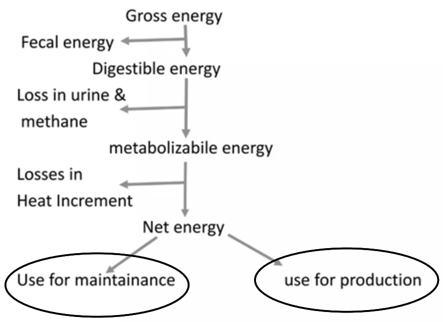
Lawrence, personal communication

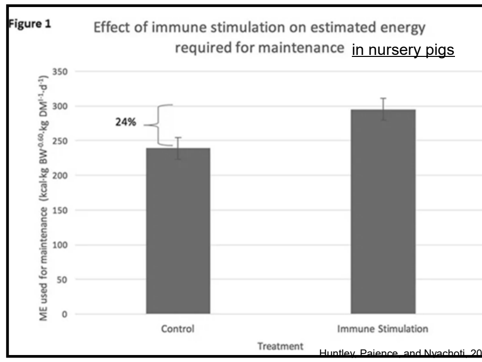


Average mass percentage of liver occupied by abscesses within the Elanco liver score category. [abc]Bars with different superscripts differ ($P < 0.05$).

NDSU

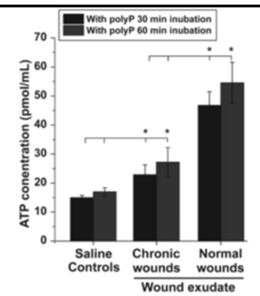
Lawrence, personal communication





- Acute LPS challenge
- Abscessed livers: lesser but more chronic effect?
- Also tissue repair

Huntley, Patience, and Nyachoti, 2017

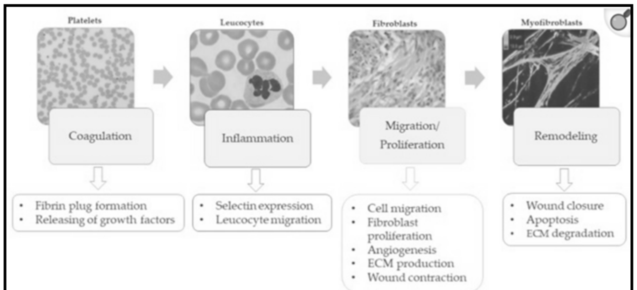


- ATP diverted for use to repair abscesses/wounds

Humans

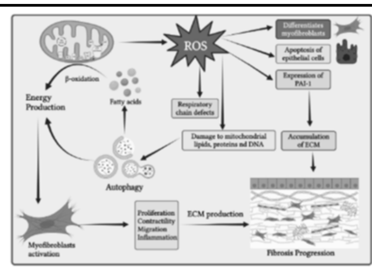
Muller 2004

NDSU



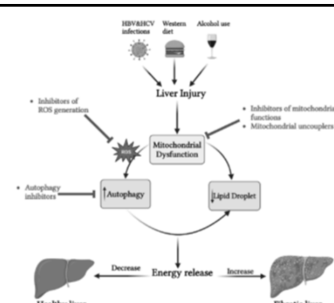
NDSU

Barchitta et al 2019



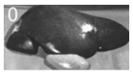
NDSU

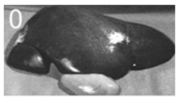
Irshad et al 2025

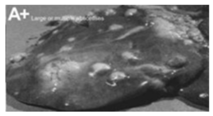


Irshad et al 2025

or







NDSU

Energetic costs of abscessed livers in calves?

- Likely contributes more than changes in liver and gut mass
  - Liver and gut absorptive surface
  - Systemic effect to support tissue repair/health
  - Compounded with other stressors, fat deposition, etc.

NDSU

Conclusions

- Management from birth on
  - Minimize stress
  - Nutrition - digestive health
- Other thoughts on nutrition
  - Amino acids, minerals, vitamins, glucose
    - Requirements not well characterized in young calves
    - Requirements increase with other stressors/health events
  - Especially in young calves and in calves that are newly-weaned
    - Potential long-term effects on productivity

NDSU

Let food be thy medicine and thy medicine be thy food.

(Hippocrates)

The Effect of Growth Enhancing Technologies on Mineral Requirements in Beef Cattle

Dr. Dathan Smerchek

IOWA STATE UNIVERSITY

THE EFFECTS OF GROWTH ENHANCING TECHNOLOGIES ON MINERAL REQUIREMENTS IN BEEF CATTLE

Dathan T. Smerchek, Ph.D.
Assistant Professor
Department of Animal Science
Iowa State University
Ames, IA

May 9, 2025

OUTLINE

- Introduction + Current Industry trends
- How do growth enhancing technologies (GET) affect trace mineral requirements and growth performance?
  - Zn
  - Cu

  Discuss of research in these areas that inform our recommendations.
- Practical application, recommendations, feeding strategies.
- Take home message

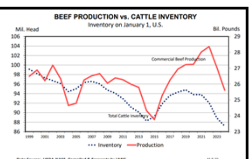
IOWA STATE UNIVERSITY

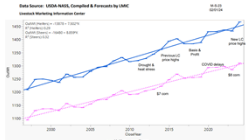
Beef Industry Trends - Where are we now?

Major advances:

- Beef cattle genetics
- Growth enhancing technology use
- Increased DOF and Outweight
- Precision cattle feeding
  - **Increase in total pounds of beef produced (Drouillard, 2018).**
    - Achieved despite shrinking cow herd numbers.

- **From 1977 to 2007, a 44% increase in beef cattle growth rates occurred** (Capper, 2011).
- **In SA: carcass size grew by 60-70% from 1970 to 2019**

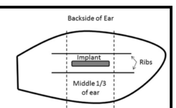




IOWA STATE UNIVERSITY

ELANCO Benchmark Database data

Growth Enhancing technologies (GET) – Beef Cattle



STEROIDAL IMPLANTS = *consistent, valuable technology*

- **Combination TBA + E2 steroidal implants:**
  - ↑ growth rate 8% to 28%
  - ↑ feed efficiency 5% to 20%
  - ↑ lean tissue mass of the carcass 3% to 10%
  - ↑ ribeye area 4%
  - ↑ DMI 6%
    - (Duckett and Pratt, 2014; Johnson and Beckett, 2014)

↑↑ Productive efficiencies of cattle feeding

- **More than 90% of feedlot cattle are given at least one implant (APHIS, 2013).**
  - ↑Protein synthesis and ↑muscle growth
    - *TM are essential in these processes!*

IOWA STATE UNIVERSITY

Growth Enhancing technologies (GET) – Beef Cattle

BETA AGONISTS:

- Ractopamine hydrochloride β1 (**Optaflexx**—Elanco, **Actogain** 45–Zoetis)
  - Provide 70 to 430 mg/hd/d for the last 28 to 42 days on feed.
- Zilpaterol hydrochloride β2 (**Zilmax**—Merck)
  - Feed last 20-40 days on feed. 6.8 grams/ton to provide 60 to 90 mg/head/day.
- Lubabegron fumarate β3 (**Experior** – Elanco):
  - Feed for last 14 to 91 days to provide 13 - 90 mg lubabegron/head/day.

All of these compounds cause general improvements in:

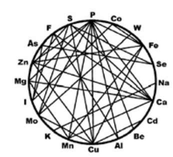
- Live body weight gain, carcass yield, REA
  - ↑ Protein synthesis
  - ↑ Muscle growth

TM are essential in these processes!

IOWA STATE UNIVERSITY

General Introduction - Trace Minerals

- Small component of diet….
  BUT they're extremely important!
- **Essential for MANY physiological and metabolic processes:**
  - *Skeletal development*
  - *Protein synthesis/Muscle growth*
  - *Energy metabolism*
  - *Immune response*
  - *Antioxidant capacity*
  - *And much more!*



Proper TM nutrition is ESSENTIAL for optimal performance!

Especially when using growth enhancing technologies

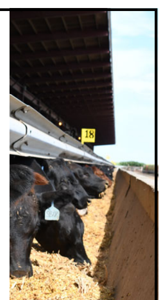
IOWA STATE UNIVERSITY

Typical TM supplementation in feedlot diets

Various TM are supplemented at greater than NASEM recommendations (Samuelson et al., 2016).

Niedermeyer et al., 2018:

	NASEM		Industry
Cu, mg/kg	10.0	2×	20.0
Zn, mg/kg	30.0	3.3×	100.0
Mn, mg/kg	20.0	2.5×	50.0
Se, mg/kg	0.10		0.30
Co, mg/kg	0.15		0.20
I, mg/kg	0.50		0.50



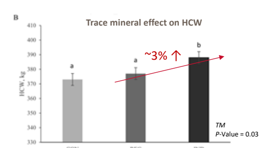
IOWA STATE UNIVERSITY

Is it effective?

- **Niedermeyer *et al.*, 2018**
  1) **NASEM** TM concentrations (**10 Cu, 30 Zn, 20 Mn,** 0.10 Se, 0.15 Co, and 0.50 I; mg/kg)
  2) **Industry** TM concentrations (**20 Cu, 100 Zn, 50 Mn,** 0.30 Se, 0.20 Co, and 0.50 I; mg/kg)
     – based on Samuelson et al., 2016
  3) **Unsupplemented controls**

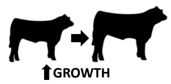
- Non-implanted: IND vs Unsupplemented
  → 13 kg advantage in HCW
- Implanted: IND vs Unsupplemented
  → **17 kg advantage in HCW**

This finding was the catalyst a series research trials!
→ Raised new questions!



IOWA STATE UNIVERSITY

Working model for GET x trace mineral interaction



1. Cattle growth rates have increased (genetics, nutrition, etc.)

2. Implants and beta-agonists support and provide increased growth

3. TM are essential in supporting growth processes

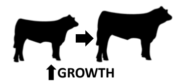
4. Implants appear to influence TM homeostasis, possibly TM requirement

5. Greater concentrations of supplemental TM (Co, Cu, Mn, Se, and Zn) increased implant-induced growth (Niedermeyer, *et al.* 2016)

6. Work focused on Zn found greater concentrations of supplemental Zn further improves GET-induced growth

Working model for GET x trace mineral interaction

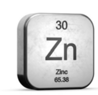
Gaps and questions within the model



- Are all TM requirements the same for this animal that continues to grow larger and faster?
  - Do NASEM recommendations allow for *optimal* growth?
    - Current TM requirements were established nearly 40 years ago (NRC, 1984)
    - Consideration: TM requirements are set to prevent deficiencies
      - Mn = 20 mg Mn/kg DM; Zn = 30 mg Zn/kg DM, Cu = 10 mg Cu/kg
- Is there an 'optimal' concentration of available Zn (or other TM) needed in the diet to support a given growth rate?
- **Is more, better?**

FINISHING PHASE RESEARCH:
Zinc x GET

ZINC



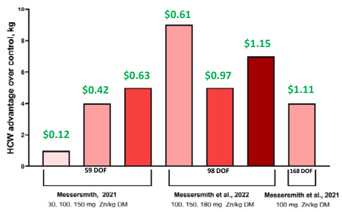
Zinc is the most utilized trace mineral in biological processes.

- Enzyme cofactor; more than 300 Zn metalloenzymes
- **Extracellular matrix remodeling**
- **Satellite cell function**
- **Protein synthesis**
- **IGF-1 and insulin function**
- Antioxidant capacity
- Component of transcription factors.
- Immune function

Muscle growth!

- **Zn is not well stored or recycled well in the body. Must be constantly supplemented!**
  - There is not a reliable biomarker of Zn status

Increased Zn supplementation improves growth performance and hot carcass weight in implanted cattle

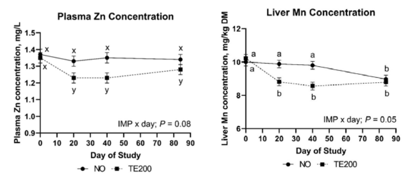


Price listed = cost to supplement $ZnSO_4$ for the feeding period.

Sizeable improvements in economically relevant carcass trait with a comparatively small input cost!

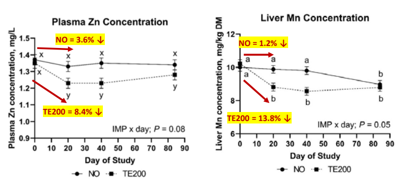
IOWA STATE UNIVERSITY

Plasma Zn and liver Mn concentration



IOWA STATE UNIVERSITY

Plasma Zn and liver Mn concentration



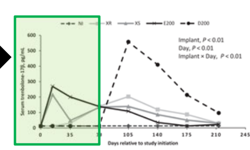
IOWA STATE UNIVERSITY

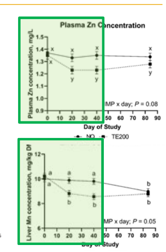
Implant administration decreases plasma Zn and liver Mn

Decreased plasma Zn and liver Mn coincide with peak hormone pay out!

Typical non-coated steroidal implant serum TBA payout curve *(solid black line)*

Figure from Smith et al., 2018 →





IOWA STATE UNIVERSITY

Experimental Design

Dietary treatments (ZINC; supplemented as $ZnSO_4$ *starting on d -60*):

- **Zn0:** no supplemental Zn (analyzed **53 mg Zn/kg DM**)
- **Zn30:** 30 mg supplemental Zn/kg DM; (analyzed **83 mg Zn/kg DM**)
- **Zn100:** 100 mg supplemental Zn/kg DM; (analyzed **157 mg Zn/kg DM**)

Implant treatments (IMP; administered on d 0):

- **NO:** no implant
- **TE200:** High potency combination implant *(TE-200, Elanco, Greenfield, IN; 200 mg TBA + 20 mg E_2)*

IOWA STATE UNIVERSITY

Zn supplementation (30 & 100) improved early implant growth performance

	NO			TE200				ZINC within NO		ZINC within TE200		Within TE200
	Zn0	Zn30	Zn100	Zn0	Zn30	Zn100	SEM	L	Q	L	Q	No Zn vs Zn
Steers	24	24	24	24	24	24						
Day 0-28												
d 0 BW, kg	466	469	472	473	474	470	3.7	0.22	0.81	0.52	0.70	0.84
d 28 BW, kg	515	516	523	530	537	537	4.9	0.22	0.79	0.89	0.30	0.41
ADG, kg/d	1.74	1.74	1.80	2.02	2.20	2.21	0.072	0.55	0.87	0.12	0.19	0.04
DMI, kg/d	11.7	11.6	12.0	11.8	12.1	12.0	0.24	0.19	0.52	0.73	0.48	0.44
G:F	0.150	0.149	0.149	0.172	0.186	0.186	0.0058	0.90	0.90	0.14	0.17	0.04

IOWA STATE UNIVERSITY

Zn supplementation (30 & 100) improved early implant growth performance

	NO			TE200				ZINC within NO		ZINC within TE200		Within TE200
	Zn0	Zn30	Zn100	Zn0	Zn30	Zn100	SEM	L	Q	L	Q	No Zn vs Zn
Steers	24	24	24	24	24	24						
Day 0-28												
d 0 BW, kg	466	469	472	473	474	470	3.7	0.22	0.81	0.52	0.70	0.84
d 28 BW, kg	515	516	523	530	537	537	4.9	0.22	0.79	0.89	0.30	0.41
ADG, kg/d	1.74	1.74	1.80	**2.02**	**2.20**	**2.21**	**0.072**	0.55	0.87	0.12	0.19	**0.04**
DMI, kg/d	11.7	11.6	12.0	11.8	12.1	12.0	0.24	0.19	0.52	0.73	0.48	0.44
G:F	0.150	0.149	0.149	**0.172**	**0.186**	**0.186**	**0.0058**	0.90	0.90	0.14	0.17	**0.04**

IOWA STATE UNIVERSITY

BUT…no significant overall growth performance results

	NO			TE200				ZINC within NO		ZINC within TE200		Within TE200
	Zn0	Zn30	Zn100	Zn0	Zn30	Zn100	SEM	L	Q	L	Q	No Zn vs Zn
Steers	24	24	24	24	24	24						
OVERALL												
d 90 BW, kg	600	595	604	620	628	625	6.2	0.54	0.38	0.68	0.42	0.38
ADG, kg/d	1.49	1.43	1.46	1.64	1.71	1.72	0.045	0.76	0.34	0.25	0.36	0.14
DMI, kg/d	11.2	11.6	11.6	11.6	11.8	11.8	0.23	0.25	0.20	0.55	0.72	0.47
G:F	0.135	0.122	0.126	0.141	0.146	0.146	0.0036	0.22	0.02	0.40	0.44	0.25

This was not the result we expected based on our prior body of work

IOWA STATE UNIVERSITY

Increased Zn supplementation did not significantly improve HCW

	NO			TE200				ZINC within NO		ZINC within TE200		Within TE200
	Zn0	Zn30	Zn100	Zn0	Zn30	Zn100	SEM	L	Q	L	Q	No Zn vs Zn
Steers	24	24	24	24	24	24						
Carcass Characteristics												
HCW, kg	379	380	385	397	402	398	4.0	0.29	0.99	0.95	0.37	0.51
REA, cm²	92.0	91.7	90.8	94.0	96.4	92.1	0.22	0.54	0.99	0.17	0.11	0.90
RF, cm	1.42	1.30	1.40	1.40	1.32	1.35	0.028	0.94	0.23	0.77	0.43	0.45
DP, %	63.1	63.7	63.7	63.9	64.0	63.9	0.29	0.19	0.22	0.90	0.86	0.97
Marbling[a]	546	546	550	521	478	549	21.6	0.87	0.99	0.16	0.06	0.79
YG	2.71	2.70	2.87	2.87	2.65	2.83	0.116	0.26	0.66	0.93	0.15	0.35
EBF, %	30.5	30.0	30.6	30.4	29.5	30.6	0.42	0.67	0.30	0.40	0.08	0.56

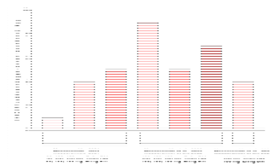
[a]Marbling scores: slight = 300, small = 400, modest = 500, moderate = 600.

IOWA STATE UNIVERSITY

Conclusions: Zn x implant – overall perspective

1. Zn supplementation ↑ growth d0 to d28 post-implant
2. Overall performance not significantly affected … (why?)

Why did results in my experiment differ slightly from prior work?

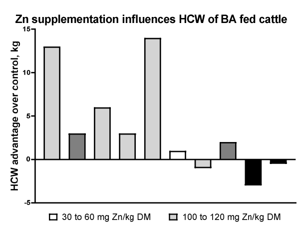


Considerations

- *Supplemented Zn for 60 d pre-implant*
- *Basal diet contained 53 mg Zn/kg DM*
    - *Total dietary Zn of at least 83 mg/kg DM was adequate to support implant-induced gain*
- *Growth potential of cattle?*

IOWA STATE UNIVERSITY

Changing gears: How do beta-agonists influence tissue Zn demand?



IOWA STATE UNIVERSITY

The effects of increasing supplementation of zinc-amino acid complex on growth performance, carcass characteristics, and inflammatory response of beef cattle fed ractopamine hydrochloride

- Forty-two Angus crossbred steers (initial BW 380 ± 5.3 kg).
- Assigned to 1 of 4 treatments for 86 d (pre-RAC period): a dry-rolled corn-based diet supplemented with:

INORGANIC

1. 60 mg Zn/kg from **$ZnSO_4$** (**CON**; analyzed 88 mg Zn/kg DM)
2. CON diet supplemented with 30 mg Zn/kg (**Zn30**; n = 12 steers)
3. CON diet supplemented with 60 mg Zn/kg (**Zn60**; n = 12 steers)
4. CON diet supplemented with 90 mg Zn/kg (**Zn90**; n = 11 steers)

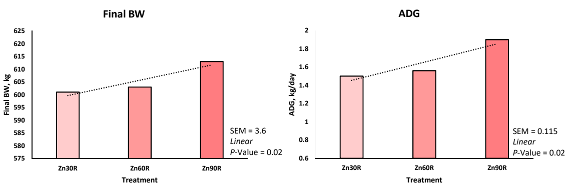
ORGANIC
Zn source: **Zn amino-acid complex** (ZnAA; Availa-Zn; Zinpro Corporation, Eden Prarie, MN).

- On day 88, half of the pens began Ractopamine supplementation, half remained with no RAC supplementation

IOWA STATE UNIVERSITY

Genther-Schroeder et al., 2016

Greater Zn supplementation improved ADG, final BW, and feed efficiency of RAC supplemented steers



IOWA STATE UNIVERSITY

Genther-Schroeder et al., 2016

GET x Zn supplementation: Summary

- **Steroidal implants and BA feeding increases tissue Zn demand and alters Zn 'requirement':**
  - Growth performance data (both)
    - *HCW, ADG, BW*
- **Supplementing Zn at approximately 100 mg Zn/kg DM likely best allows for optimal implant-induced growth and beta agonist-induced growth.**
- **Should we revisit how we define 'requirement' in modern beef production?**

IOWA STATE UNIVERSITY

FINISHING PHASE RESEARCH: Manganese

IOWA STATE UNIVERSITY

MANGANESE

25 Mn 54.93 Manganese

Functions: Nitrogen metabolism, mitochondrial function, CHO metabolism, bone, cartilage, and connective tissue synthesis, muscle growth.

- **Liver Mn does not like to change, very tightly regulated in the liver.**

Prior Mn work:

- **Legleiter, 2005:**
  - Supplemented concentrations of 0 up to 240 mg Mn/kg of DM.
    - Increasing supplemental Mn ***did not increase growth performance***.
    - Had a small effect on liver Mn (12.1 – 15.1 mg/kg)
  - BUT…liver Mn decreases following implant administration (Messersmith, 2018; Reichhardt et al., 2021; Messersmith et al., 2022).
    - **So, is increaesd dietary Mn supporting this implant growth repsonse?**

IOWA STATE UNIVERSITY

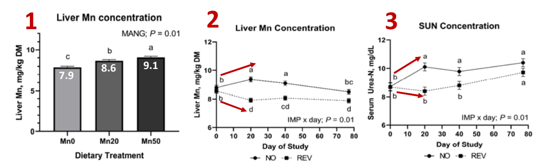
Mn Experimental Design

- **Dietary treatments** (MANG; supplemented as $MnSO_4$):
  - **Mn0:** no supplemental Mn (**analyzed 14 mg Mn/kg DM**)
  - **Mn20:** 20 mg supplemental Mn/kg DM; (analyzed 33 mg Mn/kg DM)
  - **Mn50:** 50 mg supplemental Mn/kg DM; (analyzed 57 mg Mn/kg DM)
- **Implant treatments** (IMP; administered on d 0):
  - **NO:** no implant
  - **REV:** High potency combination implant (Revalor-200; 200 mg TBA + 20 mg E_2, Merck Animal Health, Madison, NJ)

IOWA STATE UNIVERSITY

Mn Experimental Design

- Liver Mn – **Tightly regulated in the body → doesn't like to change.**



IOWA STATE UNIVERSITY

Mn did not impact overall growth performance

	MANG				IMP			P-value		
	Mn0	Mn20	Mn50	SEM	NO	REV	SEM	MANG	IMP	MANG*IMP
OVERALL										
d 0 BW, kg	463	467	461	2.3	464	464	1.9	**0.22**	0.96	0.34
Final BW, kg	617	613	612	3.7	604	624	3.0	**0.63**	0.01	0.55
Overall ADG, kg/d	1.74	1.66	1.69	0.028	1.58	1.82	0.023	**0.14**	0.01	0.22
Overall DMI, kg/d	10.9	10.9	11.0	0.15	10.9	11.0	0.13	**0.89**	0.34	0.77
Overall G:F	0.157	0.150	0.153	0.0026	0.145	0.163	0.0021	**0.18**	0.01	0.25

d -55 BW served as a covariate in analysis for all growth performance measures

IOWA STATE UNIVERSITY

Mn did not impact hot carcass weight

Mn supplementation and steroidal implants influence on carcass characteristics in beef steers.

	MANG				IMP			P-Value		
	Mn0	Mn20	Mn50	SEM	NO	REV	SEM	MANG	IMP	MANG*IMP
HCW, kg	393	391	390	2.0	384	398	2.0	0.54	0.01	0.20
REA, cm^2	**84.6^a**	**81.3^b**	**82.6^{ab}**	**0.8**	82.0	83.7	0.6	**0.01**	0.07	0.98
RF, cm	**1.53^y**	**1.50^y**	**1.68^x**	**0.06**	1.56	1.58	0.05	**0.08**	0.82	0.26
DP, %	63.9	63.6	63.7	0.002	63.6	63.8	0.002	0.55	0.35	0.45
Yield Grade	3.56	3.64	3.91	0.086	3.65	3.83	0.069	0.25	0.84	0.23
Marbling[2]	489	514	493	12.4	483	495	10.2	0.45	0.34	0.94
KPH	2.7	2.6	2.6	0.11	2.2	2.8	0.09	0.36	0.34	0.12

[1]d -55 BW served as a covariate in analysis.

IOWA STATE UNIVERSITY

Mn - Takeaways

Dietary Mn of 14 mg/kg DM did not seem to limit growth of implanted or non-implanted cattle.

Manganese:
- **20 mg Mn/kg DM is adequate in most practical situations.**
  - Sufficient to offset potential Mn antagonists (such as Fe).

IOWA STATE UNIVERSITY

IOWA STATE UNIVERSITY

COPPER

Copper is an essential trace mineral that plays a role in numerous biological processes:
- Extracellular matrix (lysyl oxidase)
- Oxidative phosphorylation (cytochrome c oxidase)
- Free radical scavenging (superoxide dismutase)
- Ceruloplasmin (Fe mobilization, antioxidant, Cu transport)
- Among many others!

- **UNLIKE Zn and Mn can accumulate in the liver with prolonged supplementation**
  - **Liver Cu reference ranges (125–600 mg Cu/kg DM;** *Kincaid, 2000***)**
- **Liver Cu CAN be a useful indicator of "status"**

IOWA STATE UNIVERSITY

Does Cu "status" impact Ractopamine response

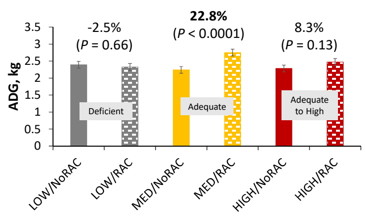
- Created treatment groups with 3 distinct liver Cu statuses. (LO, MED, HI)
  - GOAL: maintain liver Cu distinctions throughout the current trial.
  - LO, MED, and HI received 0, 10, or 20 mg of supplemental Cu/kg DM from Cu amino acid complex (Zinpro Availa Cu)

OBJECTIVE: Determine if performance and carcass characteristics of beef steers were differentially affected by three distinct liver Cu concentrations.

Messersmith et al., 2021

IOWA STATE UNIVERSITY

Cu "status" impacts Ractopamine response



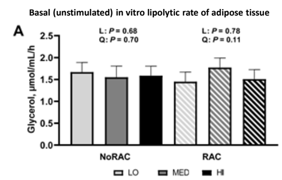
Messersmith et al., 2021

IOWA STATE UNIVERSITY

Cu supplementation influences how RAC functions

Quadratic growth response may be related to lipolytic rate

As affected by dietary Cu supplementation or Cu status of steers (as assessed by liver Cu concentrations)



In vitro lipolytic rate of adipose tissue from steers fed 0, 10, or 20 mg Cu/kg DM for LO, MED, and HI, respectively, and 0 (NoRAC) or 300 (RAC)

Messersmith *et al.*, 2021

IOWA STATE UNIVERSITY

Copper status affects Experior response

Previous study resulted in cattle with 2 distinct Cu status groups:

1) Adequate (**ADE**): 193 ± 31 mg Cu/kg liver DM fed 10 mg Cu/kg diet DM in present study
2) Deficient (**DEF**): 42 ± 21 mg Cu/kg liver DM; fed no supplemental Cu in present study

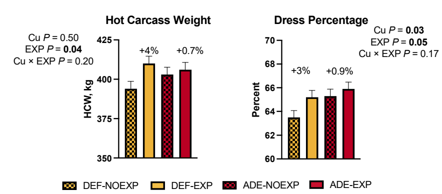
Steers stratified by liver Cu within treatment into pens equipped with GrowSafe bunks

1) Experior (36 mg/head/day starting 40 d prior to harvest)
2) No Experior

Henderson et al., 2024 *unpublished*

IOWA STATE UNIVERSITY

Copper status affects Experior response



Henderson et al., 2024 *unpublished*

IOWA STATE UNIVERSITY

Copper take home message:

- **Cu-status impacts beta agonist response.**
  - Cu deficiency in both experior and RAC results in impaired beta agonist response
  - But excess Cu also results in a blunted RAC response

NRC

Feedlot cattle do not need greater than NRC (10 ppm) recommendations

IOWA STATE UNIVERSITY

OVERALL TAKEHOME

All TM are NOT created equally.

Different functions, different storage, different requirements!

- **Zn = 100 mg/kg DM** (Greater than NRC)
- **Mn = 20 mg/kg DM** (NRC)
- **Cu = 10 mg/kg DM** (NRC)

More is not always better.

IOWA STATE UNIVERSITY

What’s Going on with Carcass Size?

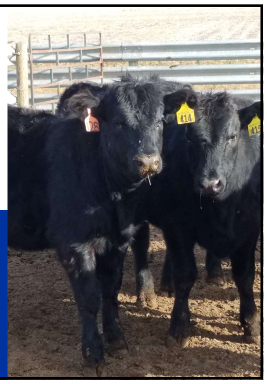
Dr. Warren Rusche

South Dakota State University Extension

What's Going on With Carcass Size?

2026 Dairy Beef Shortcourse

Warren Rusche, Assistant Professor, SDSU Extension Feedlot Specialist



1

Bigger, Better Beef?

- Email response:
- *"How big is big enough, what size cuts do consumers want? If we would just focus on efficiency, we could make more money raising medium sized, efficient calves."*

South Dakota State University Extension 2

2

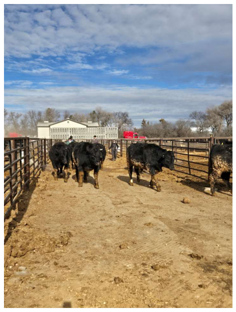
What We Will Do Today

- Share reasons why carcass weight has increased (and likely will in the future)?
- What are the implications of this trend?
- What are possible responses for dairy derived cattle?

South Dakota State University Extension 3

3

What's Going on With Carcass Size?



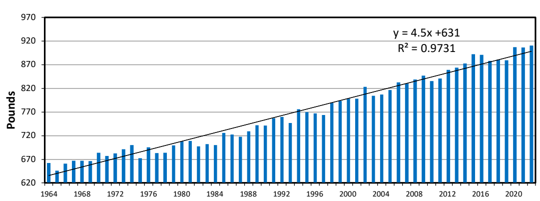
South Dakota State University Extension

4

4

Carcass Weights Over Time

South Dakota State University Extension



Data Source: USDA-NASS
Livestock Marketing Information Center

5

5

Days on Feed and Genetics Research

- Partnered with North American Limousin Foundation
- Compared nine sires (comparable growth characteristics)
  - Angus
  - Limousin
  - Lim-Flex
- Resulting calves fed at SD State University
  - Individual feed intake
  - Three different market date end points

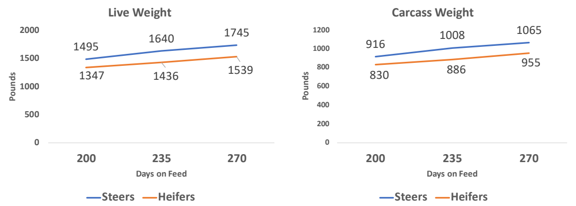
LIMOUSIN
NORTH AMERICAN LIMOUSIN FOUNDATION

South Dakota State University Extension

6

6

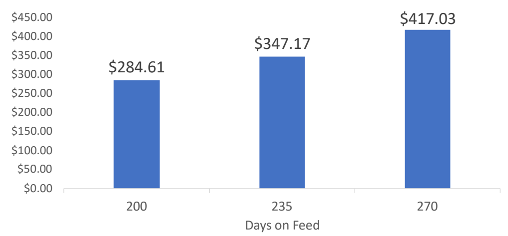
Days on Feed & Weight



South Dakota State University Extension 7

7

Profit by DOF



South Dakota State University Extension 8

8

What Can Go Wrong?

South Dakota State University Extension 9

9

Can Carcasses and Retail Cuts Get Too Big?

- Can packers chill carcasses fast enough?
- Increased carcass size = increased ribeye (and all muscles)
- Rib & loin are about 40% of carcass value
- If cuts get too large:
  - Too expensive per package – reduce demand?
  - Cut thinner steaks – less consumer satisfaction?

South Dakota State University Extension 10

10

What About Steak Size?

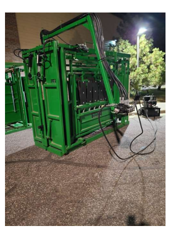
- Will we see creative beef cutting approaches?
- Examples:
  - Beef ribeye cap steak
    - $20/lb in June 2018
  - "Manhattan" steak
- Sharp knives are valuable tools!

South Dakota State University Extension 11

11

Can We Manage Bigger Cattle?

- Cattle handling, equipment, and transportation?
- What about cattle health?
  - Feet and skeletal structure?
  - Heat stress (especially black-hided cattle)?
  - Late-term deads in the feedlot?



South Dakota State University Extension 12

12

Carcass Bruising – NCBA Beef Quality Audit

Bruising Rate	2011	2022
None	77	48
1	19	30
2	3	15
3	0.6	6

South Dakota State University Extension 13

13

How About Physical Space?

- "Thumb rules" established 20+ years ago
- Do they still apply with increased out weight?
- Do we need to reduce stocking rate?

South Dakota State University Extension 14

14

How Do We Manage Cattle in the Future?

South Dakota State University Extension 15

15

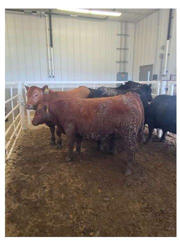
What About Tomorrow?

- Things Cattle Feeders Need
  - Cattle that stay healthy
  - Cattle that perform
    - **Heavy carcass weights**
    - **High ADG**
    - **Efficient growth**
  - Capture premiums with manageable discounts

16

More Tools to Help Us Manage Growth

- Feedyard technology that increases output
  - Implants
  - Beta-agonists
- Management decisions
  - Longer days on feed
  - Nutritional strategies



17

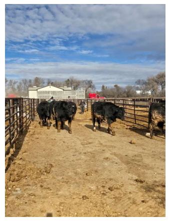
Expanded Use of Forage Systems?

- Do you have resources to "frame out" cattle?
- Grazing
  - Range
  - Annual forage or residue
- Backgrounding systems
- We could use more data on how to better use these strategies

18

Extended Forage in Beef on Dairy

- SDSU Research
- Evaluated high-forage receiving diet in Angus × Holstein steers
  - Initial wt. = 423 lbs
  - 60% Corn silage
  - 28, 56, or 84 d
  - 283 days on feed



South Dakota State University Extension 19

19

Effect of Extended Forage

	28 Day	56 Day	84 Day
Final Body Wt., lbs	1501	1487	1465
Hot Carcass Weight, lbs	842	934	920
Rib fat, in	0.60	0.60	0.54
ADG, lbs	3.80	3.75	3.67
Feed conversion	5.69	5.77	5.89

South Dakota State University Extension 20

20

Could We Use Forage to Extend Days?

- Comparing 28-d with 84-d
- More roughage = 0.06 less rib fat
- Feeding to equal rib fat
  - 17 more days on feed
  - 34 pounds increased carcass weight
  - Galyean et al., 2022
- Results in more saleable product
  - 954 pounds – 84 days roughage & 300 days on feed
  - 942 pounds – 28 days roughage & 283 days on feed

South Dakota State University Extension 21

21

Is That Profitable?

- Feeding longer increases cost about $65/head
  - Net feed increase
  - Yardage (75 cents per day)
  - Interest (about 70 cents per day)
- Added weight increases revenue $46/head ($380/cwt)
- Negative $19/head
- Can we affect health and late deads?
  - Need 0.5% reduction in death loss

South Dakota State University Extension 22

22

How About Grazing?

- Oklahoma State Study
- Grazed vs. direct to feed Beef × Dairy crosses
  - Increased outweight
  - Reduced costs
  - Similar net return
  - Beef × dairy cattle needed to learn how to graze

South Dakota State University Extension 23

23

Using Available Genetic Tools

- Genetic selection and breeding systems
  - Targeted sire selection
  - We've moved past cheap & black!
- Using existing tools to improve selection accuracy
  - Specific indexes for selecting bulls for dairy

South Dakota State University Extension 24

24

Cattle Comfort & Soundness

- Mud & adverse conditions greater impact on heavier cattle
- Floor management in barns
  - Entry weight?
  - Mats (and replacement strategy)
  - Bed pack management
  - Plan for fall-out cattle?
- Feet & legs

25

Take Home Message

- Economic signals point to increased carcass weight
- Systems that can produce more output will be rewarded
- Don't go backwards on product quality
- How do we communicate value and get paid?

26

South Dakota State University Extension

Warren Rusche
SDSU Extension Beef Feedlot Management Specialist
SAS 217, Box 2170
Brookings, SD 57007

Office: 605-688-5452
Mobile: 605-350-6633
Warren.Rusche@sdstate.edu

extension.sdstate.edu

27